

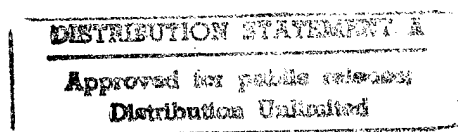
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USSR Report

MACHINE TOOLS AND METALWORKING EQUIPMENT



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1 DECEMBER 1986

USSR REPORT
MACHINE TOOLS AND METALWORKING EQUIPMENT

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NEW TECHNOLOGY ADOPTION URGED; U.S. LUNAR TECH TRANSFER BENEFITS SEEN

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 5, May 86 pp 87-88

[Article by Academician V. V. Struminskiy: "Radically Accelerating the Introduction of Progressive Technologies"]

[Text] Soviet scholars have been extremely pleased with the CPSU's energetic action aimed at eliminating wastefulness, enhancing labor and production discipline, and boosting the pace at which scientific and technical progress is made.

In his speeches, CPSU Central Committee General Secretary M. S. Gorbachev has emphasized that we need to make revolutionary progress; that is, to shift to fundamentally new technical systems. The principle goal is to reorient ourselves toward production of a new generation of machinery and equipment conducive to the introduction of advanced technologies.

Technology has become a key field of human activity, and great importance is attached to it everywhere. For example, after its successful lunar landing, the U.S. announced that the 24 billion dollars spent on the program had been completely recouped through using the knowledge gained in the course of scientific research for developing industrial technology and the national economy.

At the USSR Academy of Sciences' Section for the Study of the Mechanics of Non-homogeneous Media, scientists have done studies using models of reactors and machinery from the most important large-volume production processes. These studies have shown considerable reserves exist in the sphere of the dynamics of heat-mass exchange and aero-dynamics. In the large reactors of the chemical industry, the flow of gas, liquid, and granular material at high temperatures and pressure is extremely heterogeneous. The result is dramatically reduced efficiency and premature wear of reactor parts. Among the many areas where such flow heterogeneities occur are bioreactors, fermenters, elevators, and grain driers.

Before the efficiency of manufacturing equipment can be raised, we need to perform systematic experimental studies and develop a theory of the motion of

dispersed and two-phase non-homogeneous media. We have made definite progress in developing this theory, and our findings are now adequate to serve as the scientific foundation for calculating and selecting the optimal parameters in designing industrial reactors. Moreover, they will serve as the base on which many industries will effect radical changes in their manufacturing operations and introduce advanced technology.

The scientists working in the industry still find it difficult to make direct use of the theory. We do not have the right to offer industry recommendations without first running experimental checks. Yet we do not have the testing equipment and stands necessary for this in the USSR, and up to now have not been able to get them built.

So far, we have proven the theory only for tube reactors with small-diameter pipe sections; such reactors are widely used in the industry. We were able to do this on small stands. Later, we worked jointly with industry institutes and successfully performed experimental operational tests. Currently, several chemical combines are using the new technology developed by the Academy of Sciences. With no capital infusions, output at these combines has increased by 15-20 percent. At a combine producing phthalic anhydride, the introduction of the new technology has yielded 1.2-1.5 million extra rubles at the facility's average rate of productivity. We need to do the same at many other enterprises and in other production processes.

In the course of introducing new technology, we have encountered considerable resistance, regardless of how convincing the results of our experiments are. What is the explanation of this?

The explanation, clearly, is that certain organizations are trying to preserve their monopoly on all scientific and technical developments in their field. This attitude, which is quite widespread in our scientific and technical organizations, should be the object of a resolute eradication campaign.

The idea of monopoly comprehends more than do inertia and conservatism. Implicit in it is the fear weak scientists and managers have of allowing "outsiders" into their midst and giving up their former quiet life-style and "comfortable situation." The monopolistic mind-set tangibly retards the technological and economic growth of our country and is potentially a serious threat to our defense capability. We must launch a resolute campaign against monopolism in science and technology.

To speed up the process of introducing new technologies, organizations within an industry that are working on solving technological problems must take part in Academy of Sciences projects as soon as the first positive results are obtained. Special provisional work collectives could be created for this purpose. In addition, everything possible should be done to support the organization of interbranch complexes, although such complexes will not be able to solve all serious problems. Ministries and industrial enterprises must bear the primary responsibility for the way specialists trained to encourage technological progress are used. In addition, they must show initiative and persistence when requesting scientific and technical assistance from the USSR Academy of Sciences.

In addition to the talented and creative scientists of our country, we need to involve scientists from other countries in the socialist community in the scientific and technical activity of the USSR.

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INDUSTRY PLANNING AND ECONOMICS

TOLYATTI MACHINE BUILDING CONFERENCE ENDS

PM301119 Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 29 Oct 86 p 3

[Text] Tolyatti--The conference on the transition of associations and enterprises in the machine building complex to complete financial autonomy continued yesterday in Tolyatti.

Unanimously noting the merits of the self-financing mechanism, which has been tested at the Volga Automobile Plant and Sumy's M. V. Frunze Science and Production Association, the participants in the conference concentrated on the problems and difficulties of the transition to new management conditions. S. Sitaryan, first deputy chairman of the USSR Gosplan, V. Dementsev, chairman of the USSR Gosbank Board, Yu. Boyev, deputy chairman of USSR the Gosplan, V. Salnikov, USSR deputy minister of finance, L. Rozenova, deputy chairman of the USSR State Committee on Prices, and L. Kostin, first deputy chairman of the USSR State Committee for Labor and Social Problems, told of the changes in planning, financing, and material and technical supply at the enterprises which from 1 January next year will switch to self-financing conditions.

Enterprise representatives analyzed the specific difficulties encountered by their collectives in the process of preparing for the transition to financial autonomy.

I. Silayev, deputy chairman of the USSR Council of Ministers and chairman of the USSR Council of Ministers Bureau for Machine Building, gave the concluding speech.

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INDUSTRY PLANNING AND ECONOMICS

MACHINEBUILDING INDUSTRY'S ECONOMIC EXPERIMENT UPDATE

Moscow IZVESTIYA in Russian 12 Sep 86 p 2

[Article by PRAVDA special correspondent E. Gonzalyez under the rubric "The USSR Supreme Soviet Between Sessions": "How Is the Experiment Going? Notes from the Session of the Standing Commissions of the Chambers of the USSR Supreme Soviet"]

[Text] The concluding speech of Minister S. Afanasyev was short. "Today's analysis of the work of Mintyazhmash [Ministry of Heavy and Transport Machine Building] is very useful for us," said Sergey Aleksandrovich. "The criticisms of the quality of our equipment and the rate of economic rebuilding are just. We will hold a special session of the ministry collegium, invite all enterprise managers to it, and especially monitor the work which was mentioned here as essential."

I thought: what did the minister's words mean? The customary polite bow in the direction of those who, sparing no time and effort, went around to the enterprises, investigated the state of affairs in the sector, gave it thought, wrote inquiries, prepared to speak and so on? Or did the view of the deputies from the side, as it were, help him, the minister, to see his large and complex industry from another perspective? The questions are far from incidental--they were provoked by several instances in the preparation of the joint commissions of planning and budgeting and of industry of the Soviet Union and the Soviet National Supreme Soviet and by the very discussion of the effectiveness of the incorporation of new management methods at Mintyazhmash.

But all in its time. The Ministry of Heavy and Transport Machine Building is one of two that were first converted to the conditions of the broad-scale economic experiment. The essence of the new management methods, in brief, is the broadest possible use of standardized principles along with an expansion of the independence and an increase in the responsibility of enterprises. It is natural that today, two and a half years later, it is extremely interesting and useful to know how this justifies itself.

A joint preparatory deputative commission was formed to study the question, headed by Saratov Obkom First Secretary A. Khomyakov. It requested the corresponding materials from 16 union ministries and departments--Gosplan, Gossnab, GKNT [State Committee for Science and Technology], Goskomtrud [State

Committee for Labor and Social Problems] and others. Thirty deputies--workers, scientists, enterprise managers, party and soviet employees--headed for the plants and associations of Mintyazhmash. A. Khomyakov and another deputy, machine-building enterprise director M. Paryshkura, spoke with ministry employees in Moscow.

Overall, several files of reports and inquiries were accumulated over several months with tables, diagrams and detailed economic analysis of almost a fourth of the enterprises of the sector.

The time came for a preliminary summing up. The preparatory commission summed them up in the presence of ministry representatives. Almost every phrase of the draft formulation provoked an argument.

"The fourth paragraph says that Mintyazhmash has not provided for the steady incorporation of the new management methods into practice," said Deputy Minister V. Aleksandrov. "We request that you write it thus: 'Mintyazhmash is still incorporating the new management methods insufficiently.'"

"So you wish to soften the phrasing?" asked A. Khomyakov.

"I think that it would be inexpedient to do that," interjected V. Veretennikov, deputy chief of the wages and economics department of the VTsSPS [All-Union Central Council of Trade Unions]. "Research at 10 enterprises has shown that the employees and specialists were very poorly informed about the new methods. How can you speak of the incorporation of that which people don't know about?"

"But after all, the ministry provided for the fulfillment of the plan according to all indicators," L. Busyatskaya, chief of the Planning and Economics Main Administration of Mintyazhmash, advanced as a new argument.

The argument continued for ten minutes. Finally, the proposal arose not to adopt a final resolution, and to see what conclusion took shape from the general discussion. L. Busyatskaya requested that immediately that "new methods" replace "economic methods," since, she said, the economic influence of the new principles was insufficient. But even this attempt to smooth out the rough spot a little was postponed.

In general, the discussion went on for hours. Some of the arguments, corrections and new formulations were accepted, but the majority were not. But why did such varied interpretations arise? It seems because the same situation was viewed from different points of view. The side view of the deputies was not obscured by the knowledge of "objective" causes and "insurmountable" difficulties. In short, they didn't have to "get into the situation." The ministry employees, however, looked from their industry outward and, apparently, needed convincing cause to change their point of view.

Roughly the same impression was created by the report of Minister S. Afanasyev at the joint session of the standing commission. This report could not be

called rosy or cheerful, but if one were to describe the report in one word, I would call it composed. What do I have in mind? By way of example:

"We have not yet assimilated economic management methods," said the minister. "Administrative methods predominate. A number of enterprise managers have turned out to be unprepared to work at high growth rates of production, labor productivity and economic indicators. While the average annual growth rate of commodity production did not exceed 3.4 percent in the 11th Five-Year Plan, the average annual rate in the 12th is 6.1. This is 1.7 times greater."

Let us try and investigate and evaluate what has been said. The words about the predominance of administrative methods can, of course, be considered serious self-criticism. But it must be taken into account that they were already stated earlier by others--in the inquiries of the preparatory commission. Stated and convincingly grounded. The words about managers "unprepared to work at high growth rates" can, of course, be considered an explanation, or can simply be a transition to these same higher rates: look, he says, what growth we are planning--can anyone really raise a hand against those who have placed such a task before themselves.

In general, the report was constructed on the principle: "This we have already done, and that--not yet, but we will do it in the near future and even do it more." In this manner, an analysis of the miscalculations, shortcomings and problems remained for the report reader A. Khomyakov and the deputies following him.

"Here it is said, for example, that the plan indicators are now being delivered to the enterprises early," fitter team leader Deputy Yu. Pochechuyev from Komsomolsk-na-Amure recalled the corresponding place in the report. "I checked with the materials-handling machinery plant in my own city. It received the plan for this year as early as September. Very good, it would seem. In December, however, the ministry made corrections in the volumetric indicators and product range of the plan. The new changes were delivered in February of 1986. The plan, moreover, was not balanced with the capacity of the plant."

"And what is the quality of the plans themselves?" questioned VTSPS Secretary K. Turysov and answered it thus: "The ministry delivered 55 plan indicators to the enterprises. This is already twice as many as envisaged by the conditions of the experiment. But the aggregated indicators are expanded to the tenth decimal place. Altogether, the number of targets sent down from above exceeds two hundred and fifty for certain associations."

Maybe it is hardest to evaluate results objectively when everything is done in a formalistic manner just as it was planned, while in reality...

"The ministry apparatus has been reduced," certified Deputy L. Sharayev, first secretary of the Nikolayevsk Obkom of the Ukrainian Communist Party, "but the flow of correspondence with the enterprises has increased. This has happened because there is a great deal of formalism in improving the management structure. By way of example, the Nikolayevsk Materials-Handling Equipment

Plant and a branch of the Soyuzprommekhanizatsiya [All-Union Industrial Mechanization] Institute have entered a scientific production association as of January 1. Over the eight months, however, they have acquired nothing else besides additional paperwork. There haven't even been any directors' councils over that time..."

The deputies participating in the discussion demonstrated convincingly that the changes associated with the transition to the conditions of the economic experiment related basically to the ministry itself and its interrelationships with the enterprises. Within the enterprises, much remains as it was before. And, first and foremost, the level of economic accountability. Deputy T. Burtseva, a milling-machine operator at the Kharkov Tractor Plant, visited the neighboring materials-handling equipment plant.

"The situation at the plant with regard to the incorporation of progressive forms of labor organization," she said, "is similar to and reflects the situation of the sector overall. The team form encompasses 75 percent of the workforce, but in reality there are no economically accountable teams. Teams that have incorporated so-called elements of economic accountability are called such teams, which is far from being the same thing."

Much more was noted by the fresh look of the deputies checking on the ministry. A considerable portion of the problems before heavy and transportation machine building, however, is familiar to the readers of IZVESTIYA. In any case to those who recently read a series of materials under the rubric "How Are You, Collective?"--the Voroshilovgrad Locomotive Building Association is subordinate namely to Mintyazhmash. And the chief problem of that association--locomotive quality--is also characteristic of many enterprises of the sector.

Many of the participants in the discussion--GKNT Deputy Chairman A. Kamenev, Gosstandart [State Committee for Standards] First Deputy Chairman B. Sokolov, Deputy Minister of Foreign Trade N. Smelyakov, one of the consumers of the sector's products, USSR deputy Minister of Non-Ferrous Metallurgy K. Arbiyev and others--spoke of product quality and poor equipment marketability, productivity and reliability.

It can be said that in criticizing Mintyazhmash without a glance toward the "objective difficulties," the participants in the session were harsh, but just. And if there arose cause for praise for something, they also did not let it pass.

"It cannot be said that the ministry does not notice its shortcomings," said report reader A. Khomyakov. "The minister issues orders on all of these issues, but organizational work that is capable of having an influence on the actual state of affairs almost does not exist."

"If only the minister himself would not interfere," A. Kamenev continued this thought. "After a verification of the work of the ministry on raising the technical level of equipment, the minister was personally concerned that there be a turnaround in the thinking of enterprise managers in this regard. And after that a turnaround arrived in fact as well. For example, we now have

pretty good indicators for the fulfillment of the new-equipment plan. Better, maybe, than the other machine-building ministries."

Nonetheless, nonetheless... As was said in concluding the discussion, chaired in joint session of the standing commission by Ukrainian Council of Ministers First Deputy Chairman Ye. Kachalovskiy, the successes of Mintyazhmash could be significant if the ministry apparatus consistently and completely observed the conditions of the economic experiment and really granted the enterprises great independence in planning and economic activity. As for the achievements in the first period of the experiment, then it looks as if they must be attributed to a considerable extent to the universal attention accorded the trailblazers by other departments.

That is how the conclusion of the discussion gradually came to pass. And after this, no one objected to some of the harsh phrasings of the draft. And Minister S. Afanasyev himself made the declaration with which we opened the story. Time will show what stands behind it.

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INDUSTRY PLANNING AND ECONOMICS

ACADEMICIANS GLEBOV, FROLOV ON SPEEDIER TOOL RESEARCH, OUTPUT

Frolov on Reconstruction Tasks

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 8, Aug 86 pp 30-31

[Opening remarks of Academician K. V. Frolov at the visiting session of the Bureau of the Department of Mechanics and Control Processes of the USSR Academy of Sciences in Leningrad under the rubric "Scientific and Technical Progress: Problems of Acceleration": "Basic Research--The Foundation for Uplifting Machine Building"]

[Text] A visiting session of the Bureau of the Department of Mechanics and Management Processes of the USSR Academy of Sciences was held in Leningrad at which tasks and plans of basic and applied research for the 12th Five-Year Plan for the institutions working under the scientific and methodological leadership of the Leningrad Science Center of the USSR Academy of Sciences were discussed. The opening remarks of department secretary Academician K. V. Frolov and the report of Leningrad Science Center Chairman Academician I. A. Glebov are published below.

The question of a radical reconstruction of machine building based on the rapid development of machine-tool building and the computer, instrument, electrical and electronic industries was posed in timely fashion at a conference at the CPSU Central Committee on questions of accelerating scientific and technical progress (June 1985). A most important role in the solution of the problems of a considerable change in the structure of machine-building production with a substantial increase in the qualitative features of machinery, instruments and equipment is played by the utilization of the results of basic research--the basis for the execution of those applied developments that really make it possible to implement the essential rapid technical retooling of the production apparatus of the country and a renewal of the technological base of the leading sectors of the national economy.

A broad front of tasks has developed before science today that requires a basic approach to the search for efficient technical and technological solutions in the sphere of the creation of new machinery that is highly

reliable, power-conserving, economical, safe in operation and aesthetic in external appearance.

Utilizing the results of the natural and technical sciences, leading design thought and technological experience and taking into account the modern social, economic, ecological and other requirements of creation within the framework of the Intensification-90 program, machinery of a qualitatively new level can be realized in the Leningrad industrial region of most important technical facilities of power- and electrical-machine building, shipbuilding, robot units and flexible production systems, based on the development of a comprehensive approach to the planning, manufacture and operation of machinery and systems.

The realization of this approach should envisage:

- a radical change in the methods of strength and design calculations, as well as the creation and utilization of new automated systems for the planning of machinery and manufacturing processes;

- the creation of modern standards and technical documentation, extremely necessary for designers, based on the latest achievements of failure mechanics, friction science and other areas of science;

- the development of the scientific bases of the purposeful application of progressive materials, including composites, in various types of machine-building structural elements;

- the further development of a theoretical basis for the development and broad-scale application of new methods and manufacturing processes of machining, strengthening and assembly--an essential condition for ensuring the required level of reliability and long service life of crucial articles;

- the creation and use of modern machinery, instruments and equipment for the all-round automated testing of materials and elements of structural elements under operating conditions, as well as the development of inspection and diagnostics equipment suitable for series manufacture that provides for the timely and reliable determination of defectiveness and the true condition of both machinery and structural elements at the stages of manufacture and service under actual conditions;

- the search for and scientific grounding of new efficient design and technological measures for maintaining the reliability and extending the service life of unique and expensive large machinery and structural elements in operation and under repair.

The existing great potential of the Leningrad Science Center of the USSR Academy of Sciences, the excellent scientific schools of mechanics and materials science and the presence of major specialists in the sphere of machine-building technology and the automation of production and control processes making use of the achievements of microelectronics and computer and information science--all of this creates the essential conditions for the powerful orientation of the Leningrad collectives toward the needs of the

technical retooling of the national economy and for the realization of the results of basic research in industrial practice.

Raising the significance of the Leningrad Science Center of the USSR Academy of Sciences in the solution of topical problems of machine building should be facilitated by the organization of the Institute of Machinery Science imeni A. A. Blagonravov of the USSR Academy of Sciences, which after a certain formation period should be converted into an independent institution of academic science. The Leningrad Branch of the Institute of Machinery Science is called upon to carry out the establishment and execution of basic research in the area of ensuring the reliability and longevity of large fundamentally new machinery and structural elements and the automation of the processes of planning, production and research and to play a leading role in the implementation of scientific and methodological management and the coordination of developments produced in the interests of the most important sectors at the scientific research institutes and design bureaus of industry as well as the higher educational institutions of Leningrad. This will undoubtedly facilitate the successful resolution of the tasks of accelerating the ascent of domestic machine building.

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Glebov on Machinebuilding Research

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 8, Aug 86 pp 32-37

[Report of Academician I. A. Glebov to the visiting session of the Bureau of the Department of Mechanics and Control Processes of the USSR Academy of Sciences in Leningrad: "The Development of Basic Research on Machine-Building Problems"]

[Text] Leningrad is a major industrial center of our country. Some 50 percent of its total production volume is in machine building. Taking into account the fact that this machine building is basically small-series production, especially acute questions of raising labor productivity have arisen in Leningrad. The point is that output per worker in machine building in small-series production does not exceed 15,000 rubles, while it can be considerably greater in other sectors--roughly 30,000 rubles in light industry and 45,000 rubles in the food industry. A detailed analysis conducted by Leningrad scientists at the initiative of the oblast and city party committees showed that the achievement of a higher rate of production and growth in labor productivity, automation and computer technology must be widely incorporated into machine building.

Group manufacturing processes lie at the foundation of automation using computer technology. By the way, the conversion of machine building to group manufacture, even without the employment of automation and computers, can generate an annual volume increase of production and labor productivity of roughly 10 percent.

The tasks of raising the rate of industrial production and increasing labor productivity are being resolved in Leningrad within the framework of the Intensification-90 territorial and sectorial program. It envisages the creation of 32 group technologies that encompass the machining of rotating bodies, base members and flat parts and gears; cold stamping; the production of integrated and printed circuits and press-formed plastic shapes; powdered metallurgy; the manufacture of tools etc. The organization of six major automated types of production, 400 automated shops, sections and lines and more than 500 units of robot equipment is projected.

Aside from the production tasks--the placement in operation of ever newer automated production systems--the program formulates the scientific research tasks that are before the Leningrad academic and sectorial institutes. Chief among these is the development of automated systems for scientific research and automated planning. The combination of an automated planning system, the technological preparation of production, flexible production systems, transport etc. into an integrated production system is economically very advantageous. Therefore, about 40 percent of the industrial facilities of Leningrad, in accordance with the Intensification-90 program, will be fully integrated systems.

The scientific and methodological guidance of the Intensification-90 program has been entrusted to the Leningrad Science Center of the USSR Academy of Sciences.

The realization of the resolutions of the CPSU Central Committee conference on questions of accelerating scientific and technical progress (June 1985) and the crucial tasks posed by the Intensification-90 program required the unification of the creative efforts of the institutes occupied with machine-building problems. The Leningrad Science Center, in conjunction with the departments of the USSR Academy of Sciences, is carrying out the scientific and methodological guidance of the activity of such institutions as the All-Union Scientific Research Institute of Metrology imeni D. I. Mendeleyev (VNIIM imeni D. I. Mendeleyev) scientific research association, the Leningrad Polytechnical Institute imeni M. I. Kalinin, the All-Union Scientific Research and Planning Institute for the Mechanical Processing of Minerals (Mekhanobr) and the All-Union Scientific Research Institute of Electrical Machine Building (VNIIElektromash). The program of basic research in the sphere of machine building for 1986-90 that will be carried out by these institutes was discussed in detail by the Presidium of the Leningrad Science Center and was presented to the Presidium of the USSR Academy of Sciences.

Much work is being conducted in Leningrad on raising product quality, and first and foremost that of machine building, under the guidance of the oblast and city party committees. The Quality program is an integral part of the Intensification-90 program. The scientific and methodological leadership of the Quality program is being implemented by the VNIIM imeni D. I. Mendeleyev. This program was developed in detail for the 12th Five-Year Plan and proposes specific scientific and technical measures directed toward raising product quality and thereby increasing exports and reducing imports from capitalist countries, especially if the imports are associated with the backwardness of

domestic industry. The development of maximum lengths, roughness parameters and surface forms according to the degree of precision of the methods and equipment, as well as high-precision methods and equipment for measuring large forces, vibrations and parameters of movement, is projected.

Work in the area of flexible production systems and robot equipment, including basic research, will be expanded in 1986-90 at the Leningrad Polytechnical Institute, and the preparation of engineering and scientific personnel will be improved. The specialists of the institute should develop the technical features and design parameters of basic machine-building equipment that is suitable for functioning under the conditions of flexible production systems. The selection of this direction of research for the Leningrad Polytechnical Institute is not accidental: the Central Scientific Research and Experimental Design Institute of Robotics and Technical Cybernetics is part of it. This is the leading organization in the country on the development of industrial robots and robots for other purposes and is responsible for the uniformity, standardization and technical evaluation of robot equipment. The institute is dominated by research being conducted in the area of automated types of production and robot equipment in the CEMA countries and according to the Intensification-90 program.

In the sphere of the basic and exploratory research that makes up about 30 percent of the scientific research work of the Leningrad Polytechnical Institute, the concept of a design synthesis of modular electro-mechanical and pneumatic robots has been proposed along with principles of the building and structure of modular control devices, software systems and control and supervisory algorithms. Methods of dynamic synthesis of the mechanical portion, taking into account the existing inflexibility and unsteadiness of robots, have been tested in the designs of new-generation robots.

The staff members of the Mekhanobr Institute have created a fundamentally new class of machine for the crushing of various types of materials: metal, ores, reinforced concrete, pulp etc. These machines make use of simultaneous influences--compression from all sides, shift deformation and lag--thanks to which the materials are demolished along the structural defects. The colleagues of the institute were also able to obtain a more solid article than from the initial integral material after the sintering of powdered iron.

One of the most science-intensive sectors of machine building is power machinery, including steam and hydraulic turbines, steam generators, heat-exchanging apparatus etc. The lead organization in the country for problems in power-machine building is the Central Boiler and Turbine Institute imeni I. I. Polzunov scientific research association. In the 12th Five-Year Plan, it will improve the thermal and start-up layouts of the power units of nuclear electric power plants of 1,000-1,500-MW [megawatt] capacity on the basis of uniform heat-exchanging equipment and will create a new generation of turbines with enhanced technical and economic indicators for the single-boiler single-turbine units of nuclear power plants. The electric-power plants also need series-produced small boiler units (800-MW capacity) that operate on low-grade coal, improved automation and diagnostics systems for boiler and turbine installations, and series-produced power-technology and recovery boilers of small and medium capacity, including boilers with low-temperature fluidized-

bed furnaces. The development of series-produced power units with fast-neutron reactors of 800-MW and 1,600-MW capacity is required, along with structural elements and design solutions for power units with increased initial steam parameters (to 600 degrees Celsius and 300-350 kilograms of force per square centimeter) of 500-800-MW capacity.

In order to cover semi-peak and peak loads, it is necessary to develop and assimilate the series production of a new generation of gas-turbine and steam-gas installations with a unit capacity of 45-150 MW and 300-800 MW respectively in the next 10-12 years with technical and economic indicators no worse than prospective world analogies. It is also necessary to create an experimental prototype of a steam-gas installation with the intra-cyclical gasification of solid fuel.

The new electrical equipment should possess high reliability and longevity. In order to ensure them, it is essential to research the long-term plasticity and crack resistance of materials under conditions of corrosive influences and transient modes, and to develop new materials, including heat- and corrosion-resistant steels and alloys, ceramic materials, and electrical insulating, anti-corrosive and anti-friction coatings. Increased reliability and longevity of electrical equipment will be facilitated by the creation of automated planning and production systems for the basic assemblies of boiler and turbine units and heat-exchanging equipment, the development of integrated systems for automated control and technical diagnostics of the state of basic electrical-equipment assemblies, and the development of methods of fractographic analysis and continuous monitoring.

In the five-year plan just begun, the developers of turbines, generators, boilers and nuclear reactors should combine their creative efforts to solve problems in the complete automation of turbine units, including their start-up and stopping. Taking into account the fact that the Central Boiler and Turbine Institute scientific research association is conducting the principal basic and exploratory research in the sphere of power-machine building and has at its disposal highly qualified personnel and an experimental base, as well as active participation in the work of the Leningrad Science Center, it seems expedient to entrust the scientific and methodological leadership of this organization to the USSR Academy of Sciences.

The scientific and technical center of large electrical-machine building in our country is VNIIElektromash. This institute, however, also resolves tasks that do not relate to large electrical-machine building, but have great significance for the national economy.

Raising the efficiency factor of working execution machinery requires the regulation of its frequency of rotation depending on the load. The demand for regulated electric motors grows with every year. The frequency of rotation is regulated by direct-current electric motors or alternating-current electric motors with semiconductor frequency converters.

After the assimilation of the production of thyristors, it seemed that in the near future the synthesis of electrical machinery and controlling semiconductor converters would supplant the commutator with brushes. Thus,

the production of direct-current motors in our country was not expanded, and scientific research in this sphere was essentially halted. The forecast, however, has turned out to be groundless. By the way, foreign firms have achieved great successes in recent years in increasing the capacity of direct-current machinery by several times and obtaining a wide range of regulation.

The underestimation of the actual situation gave rise to difficulties in domestic industry. Machine-tool building plants in particular had to purchase electronic control systems and direct-current electric motors with numerical control from abroad. In order to satisfy the requirements of domestic industry, it is essential to increase the output of direct-current motors of 1 to 1,000 kW [kilowatts] from 160,000 to 260,000 units by the end of the 12th Five-Year Plan. VNIIElektromash has begun the development of a new series of direct-current electric motors for industry based on the asynchronous electric motor, the production of which has been mechanized and automated to a great extent. The idea of creating similar machinery has not yet been considered by world practice. One of the most difficult problems on the path to its implementation is the automation of the production of armatures with a commutator. This problem has also not been solved abroad.

The colleagues of VNIIElektromash have begun exploratory research and development of direct-current electric motors for machine tools with numerical control, wherein the technical and economic indicators of these electric motors should exceed those of foreign ones. The range of rotational frequency change, for example, will be 1:1,000. Motors without housings have been proposed. The core of the coil also fills the role of yoke in them. VNIIElektromash is conducting the work on direct-current electric motors in collaboration with six plants.

Regulated electric drive for machine tools with numerical control and robots can be carried out without a commutator with brushes using a combination of a simple alternating-current electric motor with semiconductor converters. VNIIElektromash has proposed the use of inverter motors for this purpose. Their theory has been in development at the institute for over 10 years. There exists the real possibility of creating machinery for electric feed drive based on inverter motors and, in the future, electric drive for the main movements, that are not inferior to foreign ones in their features. Efforts are being undertaken to create electric spindles using inverter and asynchronous frequency-controlled motors with several kilowatts of capacity (rotational frequency on the order of 100,000 revolutions a minute), and gas and magnetic supports. High-quality power transistors, fully controllable thyristors, inexpensive permanent magnets with high magnetic features, new insulation materials and compounds and bearings rated for a rotational frequency of 10,000-20,000 revolutions a minute are needed for this.

In the basic, exploratory and applied research conducted at VNIIElektromash, principal attention is devoted to turbine and hydraulic generators. The production of electric power at thermal, nuclear and hydroelectric power plants depends to a great extent on their quality.

An analysis of the accident rate of turbogenerators has shown that plants working on their own turbogenerator designs cannot ensure high reliability

indicators (on the order of 20,000 hours of running time per failure). VNIIElektromash, with the support of the USSR Ministry of the Electrical Equipment Industry, has developed a unified design for 63- to 800-MW turbogenerators with increased reliability. The parameters of the standardized series of turbogenerators are on a par with the best foreign models.

The development of a unified series of turbogenerators required the execution of a large amount of theoretical and experimental research. In particular, three-dimensional electromagnetic and thermal fields and transitional and abnormal modes were calculated, corrosion-resistant commutator shrink rings for reinforcing the frontal portion of the winding and stator were tested, cooling was improved etc. Operating experience of the first 10 turbogenerators of the unified 160-MW-capacity series is producing good results: running time per failure has reached 27,000 hours.

Much research work and experimental operation has made it possible to raise the level of hydraulic-turbine generator reliability considerably. The running time per failure of the powerful domestic hydraulic-turbine generators is 40,000 hours, as is that of the best foreign models.

The most unreliable element of the hydraulic-turbine generator is the axial bearing. It must withstand the pressure created by the rotor and turbine masses as well as the water pressure. This is the most crucial assembly of the hydraulic-turbine generator. Unique work has been conducted in our country: axial bearings with teflon coatings have been created in place of babbitt. The new axial bearings can withstand large unit pressures, start-up and stopping under pressure without lubrication, and an operating temperature of 60 instead of 35 degrees Celsius. The latter leads to an increase in the efficiency factor of the hydraulic unit of 0.2 percent, as well as eliminates the blockage of the outer contours of the water cooling with barnacles, which perish at 60 degrees Celsius. Some 190 hydraulic-turbine generators with teflon-coated axial bearings are in operation in our country, while babbitt is preserved in foreign practice as before.

A wing for service-life testing is being built at VNIIElektromash. Assemblies and parts of electric-power machinery made from new materials will be tested there. This is a fundamentally new approach to machinery reliability and quality that is based not on their "treatment" after the analysis of accidents in operation, but on anticipatory research.

The staff members of VNIIElektromash combine work on the problems of today and yesterday with promising research. Thus, power supplies have been created with large (up to several gigajoules) power capacity. A comparison of induction accumulators, capacitors and generators with flywheels has shown that a unit parameter--power per unit of mass--is the highest for machinery with flywheels. It is assumed that, using new materials, and particularly synthetic ones that are stronger than steel, it will be possible to develop inertial accumulators with substantially greater parameters.

Still another promising direction is superconductive turbogenerators. Several generations of turbogenerators, you will recall, have been created in our

country. The first were air cooled, the second--indirect hydrogen, the third--direct hydrogen, and the fourth--hydrogen and water. By the way, that is the type of cooling used in the unified turbogenerator series. Cooling in the latest, fifth generation of turbogenerators is completely water. This cooling system is called "three waters"--the stator winding, the rotor and the stator core. The first two 800-MW turbogenerators with water cooling are successfully undergoing operational testing at the Ryazan GRES. Series production of this machinery will be set up in the second half of the 1990s.

A turbogenerator of the sixth generation is now being prepared to be connected to the Lenenergo [Leningrad Power] network in which liquid helium is the cooling agent. The first cryoturbogenerator in the world has a capacity of 20 MW and will operate in the most difficult mode--synchronized compensation. The Elektrosila Scientific Production Association is completing the manufacture of a 300-MW superconductive turbogenerator. A technically rare combination is being achieved in superconductive turbogenerators--a reduction by half and more in mass with a concurrent increase in the efficiency factor. The ordinary turbogenerators will have a maximum capacity of 2,500-3,000 MW, while the superconductive ones will have 5,000 MW and more. Power machinery of such capacity will undoubtedly be required in the 21st century.

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KOMSOMOLETS PLANT ASSIMILATES NEW, HIGH EFFICIENCY EQUIPMENT

Moscow MASHINOSTROITEL in Russian No 5, May 86 pp 6-9

[Article by G. Z. Altmark: "Incorporating Highly Efficient New-Generation Equipment"]

[Text] "Komsomolets" Machine-Tool Manufacturing Plant in Berdichev is an enterprise specialized to produce highly productive, reliable turret lathes. Its output is in great demand, both here and abroad.

The 11th Five-Year Plan was a qualitatively new stage in the activity of the Berdichev machine-tool manufacturers, as the enterprise began changing over to production of a new line of turret lathes. Thorough analysis of production reserves, constant monitoring of schedules for mastering the production of new models, strengthened implementer and production discipline, and increasingly effective socialist competition have combined to enable the enterprise collective to successfully carry out the tasks set them. The plant is rightly considered one of the best in the industry. This past five-year plan, the enterprise collective repeatedly achieved good indicators, winning prizes in the All-Union Socialist Competition among enterprises of the Minstankoprom [Ministry of Machine Tool and Tool Building Industry]. The collective carried out the five-year plan assignments and met its socialist competition commitments ahead of schedule, producing millions of rubles worth of marketable output above the plan, more than 90 percent of the increment in which was achieved through improved labor productivity.

The high pace of improvements in world machine-tool manufacturing have set the plant collective the task of mastering the production of highly efficient new-generation equipment capable of ensuring the introduction of progressive technology and of significantly increasing labor productivity and return on capital. Together with other leading organizations, plant specialists are developing a promising line of new machine tools based on the 1P420PF40 multiple-operation machining center. A prototype was demonstrated at the international "Metalworking-84" exhibit. The machine tool is designed for multipass machining of body of revolution parts, for all turning operations, as well as for drilling and milling holes, including ones offset from the axis of the part, in addition to holes in butt ends and on other surfaces, for making every sort of slot, flat spot and bevel. It incorporates the "Elektronika NTs80-31" NPC microprocessor

system, which also acts as a relayless automatic electrical system. The machine-tool can be equipped with an automatic system for measuring the surfaces being machined and adjusting the position of the tool. The anticipated economic impact of introducing one 1P420PF40 machine tool is more than 50,000 rubles.

It has been proposed that this machine tool be used as a base for manufacturing a prototype flexible production module equipped with a straddle-type robot, a parts measuring system, a magazine for blanks and cutting tools, a device for replacing chuck jaws, and so on. The anticipated economic impact of its introduction -- more than 400,000 rubles.

We have begun producing a flexible production module based on an 1V340F30 NPC lathe equipped with an "Elektronika NTsTM-01" robot. It is designed for machining parts, spiders and fitting that can be held in a chuck.

The most pressing of the many problems being successfully solved by plan designers and technologists in developing this new equipment is to improve its productivity, quality and reliability. The primary goal is to increase the trouble-free service life of the equipment. In this regard, one requirement is to reduce the lag time between testing new equipment and beginning its series production.

Machine tools developed and produced at the plant are first installed in the plant's own shops, which helps improve labor productivity and permits resolving such important tasks as improving the reliability and quality of the new equipment. After testing in the shops and confirmation of the parameters called for in the designs, the new equipment moves into series production.

Much attention is paid to implementing a comprehensive quality control system whose elements include a work package to raise the technical level of products and improve the technology and effectiveness of quality control systems and to increase operator responsibility. This approach enabled the plant collective to increase the precision of the machine tools it produces by 45 percent in the 11th Five-Year Plan, and to increase the proportion of output with the state Emblem of Quality from 11 to 59 percent of total production volume. Production smoothness was increased. The plant has received no unsatisfactory equipment reports for a number of years now. Nearly 98 percent of its output is released on first demand.

A number of steps aimed at changing the spindle head lubrication system design, bar stock support design, cooling system, increasing spindle speed (to 2,500 min^{-1}), automating shavings collection on NPC machine tools, and so on, are being taken to raise the technical level and improve the design of machine tools. Machine tool specifications are being improved as a result of these steps. In 1985, the BRST-01 machine-tool complex won state Emblem of Quality certification and the 1G340PTs and 1V340F30 lathes were re-certified for it.

Production specialization based on unitization and standardization is an important means of reducing the time involved in putting new items into production and increasing production volume with the same number of workers. The plant collective has been working along this line for some time. As each new

line of machine tools is created, the designers try to reduce the amount of metal and number of structural elements used, as their manufacture is very labor intensive and requires frequent equipment adjustments. They also try to make maximum use of the available capacities and tools. Thus, the number of parts in the 1V340F30 line was reduced by two-thirds.

Broad equipment standardization, which currently encompasses 80 percent of all parts, has led to radical changes, both in production and in designing new equipment. The nature of the designers' labor has been changed. They now develop machine-tool components as a set of structurally independent subassemblies, each of which is assembled individually. The labor productivity of the designers has been increased.

Standardization has provided an opportunity to set up the large-series manufacture of parts using special automated machine-tool equipment set up for group machining, to organize parts manufacturing using special adjustable fittings, and to reduce the number of tools used. Bookkeeping has been simplified; production planning and organization has been improved. The labor intensiveness of manufacturing each new line of machine tools has been reduced by an average of 1.5- to two-fold. The economic impact over the past two years has been 3.5 million rubles.

One important factor ensuring successful collective efforts to pick up the pace has been the improved technical level of production and increased capital investment effectiveness. Thus, over the past four years, the increment in marketable output production has been 17.8 million rubles, made possible by an investment of 4.55 million rubles in retooling. Such a high return on capital was made possible thanks to the skillful, intelligent use of capital investment which, in turn, permitted more than a two-fold increase in production volume this past five-year plan.

Intensification has fundamentally altered production. More than half the workers in the main and auxiliary shops are operating automated and special equipment. The enterprise has embarked on a qualitatively new stage of retooling. It must, in sum, create a production facility replete with automated equipment complexes and computers. Retooling has been a decisive factor in accelerating scientific-technical progress at the enterprise. The number of units of progressive equipment (now 40 percent of the total number of machine tools) is being increased in accordance with a comprehensive program for raising the technical level and increasing the competitiveness of products. The number of NPC machine tools, including machining centers and robotized complexes, has been increased to 64. Production upgrading has permitted a 1.5- to two-fold increase in worker and employee labor productivity, substantially improved working conditions, and higher production standards, due to reduced auxiliary time, optimized machining conditions, and wider service zones.

The efficient use of capacities and labor resources through job certification and improved workplace efficiency has become one way of increasing output volume and improving product quality. In this area, the plant maintains a plant-wide certification commission and shop worker certification groups, is implementing a comprehensive efficiency and product quality improvement plan, and certifies jobs and workplace efficiency annually. Job certification has, for instance, revealed

quite a lot of equipment which is being used less than full-time. As a result, the number of jobs has been reduced by 74, including ones with difficult and hazardous working conditions. Sixteen pieces of equipment have been sold, for which the plant received 64,100 rubles.

Under the target comprehensive program for raising the equipment shift index in the 11th Five-Year Plan, more than 300 obsolete and obsolescent machine tools were taken out and 211 pieces of progressive equipment were installed in their place.

Each enterprise structural subdivision has developed measures to improve the workplace. For example, a thorough time-and-motion study and analysis of operations performed per assembly production shift showed that there is considerable potential for coping with the assignments with fewer people. The shop introduced a method of assembling machine tool components with special equipment, assembly and test benches, which permitted a 3.5-hour reduction in 1V340F30 NPC machine-tool motor housing and electrical equipment installation and set up time. Labor productivity was improved 2.5-fold in the manufacture of plastic tags for conductors by putting in MA-157 automatic machines. The use of power tools in test bed assembly component subassembly permitted a 1.5-fold shortening of the technological cycle and a two-fold increase in labor productivity.

Extensive use is made of efficiency improvement proposals and inventions in the development of new equipment and in improving technological processes and revealing labor productivity growth potential. One in every seven enterprise workers participates in technical innovation. Each year, more than 200 efficiency proposals and inventions are introduced into production, with an economic impact of about 500,000 rubles.

Armed with the slogan "Engineering Support for Worker Initiative," the collective is resolving important tasks involving development of highly productive tools and machining attachments. Dozens of adjustable, multipurpose fixtures are developed each year with the help of innovators and, in combination with special adjustments, these ensure that blanks can be positioned in the machine tools quickly and securely. These include a variety of vises, lathe chucks for turning inserts, dividers for milling grooves, slots, keyways, and so on, dies for punching slots and holes, special multiposition fixtures with mechanical clamps for NPC machine tools, and so on.

Extensive use is made of plant-designed multipurpose assembly fixtures for use on milling machines, drill presses and grinders. Their use enables us to significantly improve the machining quality, to increase labor productivity two- to five-fold, and to save more than 30,000 rubles a year, without making additional attachments.

New technology for machining spiders on a special BRA-22-01 machine using an automatic clamping fixture developed by plant innovators is of interest. The spider is completely machined in a single position. Machining quality is good, labor productivity is three times better, and the economic impact of introducing the fixture is 7,500 rubles per machine tool.

Plant innovators and leading production workers have made quite a few proposals aimed at saving materials, fuel and energy. For example, the use of an electric furnace to space molds in the precision steel casting sector has enabled us to save 340,000 kW-hr of electricity a year, to improve casting quality and to save 11,000 rubles.

The creative cooperation of blue- and white-collar workers is resolving such important tasks as reducing metal use when developing new equipment. For example, implementation of a suggestion to change the design of the lower bed of a turret lathe and to change the technology for manufacturing it permitted a savings of 73 tons of iron per year and had an economic impact of 9,500 rubles. About nine tons of aluminum has been saved thanks to changes in the design of cover on a multipurpose bench-mounted machine tool. After changing the main drive control circuits on a turret lathe, nearly 9,000 rubles was saved in assembly components.

These examples testify to the high creative activeness of the Berdichev machine tool manufacturers. The plant collective was awarded an AUCCTU, Komsomol Central Committee and USSR Gosstab certificate based on results in the All-Union Public Review of Resources Economy. As do many leading branch collectives, the Berdichev machine tool manufacturers have worked out and are carrying out measures to introduce resources-conserving equipment and technology, which has enabled them to work two days on resources and materials saved.

The plant collective faces serious tasks in the 12th Five-Year Plan. It must begin developing flexible manufacturing systems and robot equipment complexes and increasing production of NPC machine tools and the flexible production modules being created based on them, all without shutting down production. "The entire increment in production volume through increased labor productivity" -- this is the main slogan of the Berdichev machine tool manufacturers.

The collective has successfully met the higher obligations assumed in honor of the 27th CPSU Congress. In the pre-Congress competition, 28 brigades and 275 workers completed the five-year assignment ahead of schedule. The No 3 shop multipurpose brigade led by V. A. Kuptsov was among them. This collective overfulfills the assignment by 25 or even 30 percent each month. All its output is released on first demand. The brigade has put forward an initiative, "First-quarter plan for 1986 by the opening of the 27th CPSU Congress," which was broadly supported at the plant.

The Komsomol youth electricians' brigade has been a model of highly productive labor. It is entrusted with installing particularly complex machine tools. Based on the results of shock-work watches stood in honor of the 40th anniversary of Great Victory, this brigade was cited as being the plant's best youth collective.

The Sector No 1 collective led by senior foreman Yu. A. Bondarchuk deserves note as one of the labor collectives which achieved high indicators in socialist competition. The collective was awarded the honorary title of "Best Minstankoprom Sector" Workers in the Shop No 4 assembly sector led by senior foreman V. I. Artemchuk have done shock work. Year after year, the Shop No 1 assemblers' brigade led by A. N. Panaskevich, recognized as one of the best in the industry,

has achieved high labor indicators. These collectives have won honorary pennants of the Minstankoprom and the central committee of the Machine-Building and Instrument Manufacturing Trade Union.

The best workers include Shop No 2 turret lathe operator Olga Opanasovna Matveychuk. For many years, this labor veteran has steadily achieved high indicators in meeting production assignments and socialist obligations. All her output is released on first demand. Her labor productivity increased by 28 percent this past five-year plan. She began working towards her 12th Five-Year Plan assignment in May of 1985. O. O. Matveychuk pays a great deal of attention to seeking out potential for further labor productivity growth, for saving materials and tools. This experienced production worker is always helping comrades, and especially young workers, developing an aware, conscientious attitude towards work in them. O. O. Matveychuk has been awarded the Order of Labor Glory Third Degree for her shock-work labor. Her name is on the Berdichev city Board of Honor and in the plant Book of Honor.

The enterprise collective is confident of successful performance of the tasks set them in the 12th Five-Year Plan. Inspired labor, the communist awareness of each member of the collective, guarantees this.

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INDUSTRY PLANNING AND ECONOMICS

GEORGIAN VOCATIONAL-TECHNICAL EDUCATION LEADERSHIP CRITICIZED

Tbilisi ZARYA VOSTOKA in Russian 11 Mar 86 p 2

[Article by Vakhtang Akhalaya under the heading "Growing Through Labor": "The Long-Range View: Leadership of the 'Stankostroitel' Production Association in Tbilisi Not Concerned About Training the New Generation of Workers"]

[Text] Concern for a worthy replacement for the working class has always been a matter of enormous state importance. However, this task is more critical now than every before, since the party has adopted a policy of accelerating the country's economic and social development based on scientific and technical progress. The Political Report of the CPSU Central Committee to the 27th CPSU Congress states: "Given the scientific-technical revolution, further transformations of labor are making heavy demands on education and vocational training." The young people mastering modern occupations connected with automation, computer and robot equipment, in today's vocational-technical schools, and especially in machine-building schools, will determine the technical level of tomorrow's production. The base enterprises and their party organizations now share with the vocational-technical education system responsibility for the quality of training of skilled workers, for their knowing this new equipment to perfection and being true production managers.

In our republic, many leaders are thoroughly aware of this responsibility, which is stated in the "Provisions on the Secondary Vocational-Technical School Base Enterprise (Association, organization) approved by the USSR Council of Ministers decree of last February. The Georgian Communist Party Central Committee recently approved the Rustava Metallurgical Plant's sponsorship work with the SPTU [special vocational-technical school] assigned to it. However, some enterprises have failed to meet the Provision's requirements. The 'Stankostroitel' production association in Tbilisi is a glaring example of administration irresponsibility towards this important problem. Moreover, this is not the first year this association has done this work chaotically. One serious problem here is personnel, and what does that mean for the future?

We will not pursue in depth here all the organizational and technical reasons for this alarming situation at the association, which was discussed at the 48th party conference of Tbilisi's Lenin Rayon when periods of stable operation had been replaced by considerably longer periods of disorder, disorganization and mismanagement, when the association was unable to consolidate the positive advances which occurred after many years of lag and failure to meet plan

assignments. We shall cite only the primary "subjective" reasons self-critically put forward at the association's report-election party conference, as these are directly related to our topic. They include disorganization, a lost sense of responsibility for the mission at hand at all levels, and lack of a sense of plant patriotism. Let me add that these should also include indifference to the fate of young workers: violation of the principle of vocational selection and job counseling, of conformity of the nature of the job to the training and interests of the workers.

All this has caused high personnel turnover at the association, the main thing being that young people are not staying here. For example, of the 140 graduates of Tbilisi SPTU No 6 assigned to the association in 1983, only seven remained at the end of last year, and of the 66 graduates assigned here in 1984, only 11 remain. Only a couple of young men remain here from among last year's graduates. Many years of experience testify to the fact that hardly any of the graduates called up for military service return to the association, and not surprisingly, as nothing at all is being done to attract young people here.

In fact, the association is not meeting a single one of its many obligations to SPTU No 6 as stipulated in the Base Enterprise Statute. Even before the issuance of the CPSU Central Committee and USSR Council of Ministers decree "On Further Developing the Vocational-Technical Education System and Increasing Its Tole in Training Skilled Personnel" in April of 1984, based on a corresponding resolution of the USSR Ministry of Machine Tool Manufacturing and the Machine-Building and Instrument Manufacturing Workers' Trade Union central committee, joint vocational-technical school and association measures had been worked out, and that plan had been signed by the association general director, G. Dzhikidze.

Major overhaul and renovation of the school classroom building and major overhaul of the workshops and dormitory were planned for 1985. Construction of new production-training workshops for 400 students, a dormitory, a dining hall and a sports facility was planned for 1986-1990. However, the association leadership did not lift a finger, as they say, in either 1984 or 1985 to even so much as order the estimate-planning documentation.

At the same time, however, the Base Enterprise Statute, which, incidentally, was approved to implement the indicated decree, required that it strengthen the material-technical base of the SPTU it sponsors and that the corresponding measures be reflected in the economic and social development plans and in the collective agreements.

"The association has long since, for the past six months in any event, forgotten about the needs of our technical school," says SPTU No 6 director Fidon Nadareishvili. "This joint plan of ours would most likely have remained on paper only had we not given up hope of assistance from our sponsors and taken the initiative. We appealed ourselves through the republic vocational education administration to the USSR Ministry of Machine-Tool Manufacturing for assistance. If you can imagine it, we solved the problem, with the assistance of the USSR Vocational Education Administration, in spite of the poor prognosis given by the association leadership: hopeless, they said....

So what happened is the association leadership, without lifting a finger to do what would have been in its own production interests, something it could have done without particular effort, only shrugged its shoulders when construction work began early this year at the school. After construction is completed by 1 September 1987, the new production training workshops will be equipped with modern numerical programmed control machine tools, thus having solved the most important problem of setting up the training of NPC machine-tool operators at the vocational-technical school, again without the association's participation.

It should be noted that the output being produced at the association has been completely updated in recent years: 45 new machine tool models and upgrades have been put into operation, including programmed-control machine tools and machine tools using micro-electronics, automatic plasma pipe-cutting lines, and so on. Flexible systems equipped with robots are being developed for turning. In the future lie machining centers and robotized complexes which will become the basis for flexible manufacturing systems. Naturally, all this very latest equipment cannot be produced using obsolescent equipment. Therefore, the association's main shops are already equipped with NPC machine tools which are eclipsing multipurpose milling lathes in auxiliary production. Thus, the demand for NPC machine-tool operators will increase swiftly here.

This school year, SPTU No 6 has begun a three-year course to train specialists in this new occupation. The necessity for this arose long ago, but the association leadership was completely unconcerned about corresponding material-technical support. It is true, they did transfer one written-off NPC machine tool to the vocational-technical school, but it turned out to be in such poor condition that it couldn't be set up at all for more than two months. Again, the SPTU leadership took the initiative promptly and created an NPC machine tool of our own, with the assistance of specialists from the State Design Institute imeni V. I. Lenin.

Back in 1984, the machine-building department at the State Design Institute began designing a mini-machinetool several times smaller than usual. A milling head was added, upgrading the machine from lathe to milling lathe. The boys worked with the production training foreman to manufacture the machine tool in the school's shops. Naturally, the association helped, by allocating us a standard machine tool control system, the cost of which, incidentally, was charged to the school.

This training machine tool has passed its first tests and will be used to train operators this school year. The school is thinking about producing more such machine tools, both for itself and for other SPTU's.

The absence of NPC machine tools in the vocational-technical school's production training workshops has heretofore prevented student training in producing output to order for the association and performing complicated tasks. In fact, that is precisely what is demanded by the Base Enterprise Statute and the "Basic Directions of Secondary and Vocational-Technical School Reform" as being the basis for improving the training-education process. These days, it is simply impossible to set up such productive labor for young people on the available obsolete machine tools.

Incidentally, how is one to expect any significant accomplishments of the association on the sponsorship path if it does not meet the SPTU half-way even in minor matters. We are charged for tools which were to have been supplied without charge. There's no way it can improve the school site by allotting us a single truck, although the promise of one was trumpeted, and so on. They are also cool towards their obligations to participate in vocational guidance for young people, towards staffing the SPTU. The association party organization has been inexplicably passive on this question.

I have already mentioned the association's problem of losing its sense of plant patriotism among a certain segment of workers. This has been exhibited not only in poor-quality output and high personnel turnover, but also in the fact that many workers do not want their children to come here to work or to study in the SPTU No 6 assigned to the association.

The CPSU Central Committee's Political Report to the 27th Party Congress states that it is "necessary to broadly celebrate labor dynasties, to support good-name traditions, to educate young people in the experience of the older generations." Who, if not the association's communists, is to be concerned with this?

The accountability report at the most recent association party conference, which discussed the personnel problem, failed to even mention the lack of vocational guidance work with schoolchildren or shortcomings in organizing their productive labor. It is not surprising that only three graduates of the No 13 secondary school it sponsors in Tbilisi have come to work at the association in recent years. The situation is similar for staffing the vocational-technical school.

As concerns the problems of acquiring the graduates of the vocational-technical school it sponsors, its roots lie only at the surface. The average wage of the graduates is generally 80 rubles, sometimes lower, that is, the enterprise hardly provides them with work in strict conformity with their skill and does not try to interest them, either materially or intellectually. By the way, for two years now, the SPTU has borne equal responsibility for securing places for its graduates.

Neither is the association in a hurry to provide the vocational-technical school computer classroom with the equipment planned, although it has every opportunity to do so.

The Machine-Building Plant imeni S. Kirov ("Stankostroitel" production association) and SPTU No 6 are next door to each other. But they are separated by more than a brick wall. When you walk along that wall across Magnitogorsk cul-de-sac, the dirty street strewn with trash that leads to the vocational-technical school, you find yourself thinking how short-sighted is the position taken by those base-enterprise leaders who neglect the schools, who still consider sponsorship work somehow non-mandatory and burdensome. The reference is to more than the direct and concrete interests of these enterprises. Without their participation, tasks of statewide importance will not be solved: sharp improvement in the social prestige of the entire republic vocational-technical education system, its transformation into a genuine center for the labor education of young people and for training a worthy worker generation. Broad

implementation of the Leninist principle of unifying training and productive labor and the reform process, dictated by the times, of radically improving the preparation of young people for independent work and living, tasks which the 27th CPSU Congress pointed out must be resolved faster, are being delayed in the cul-de-sac of short-sightedness.

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INDUSTRY PLANNING AND ECONOMICS

MACHINE BUILDING EXHIBIT ON NEW TECHNOLOGY

Moscow NTR: PROBLEMY I RESHENIYA in Russian No 10, May-Jun 86 p 2

[Article by S. Pavlova: "At the Highest Level"]

[Text] An exposition, "Soviet Inventions and Scientific and Technical Progress in Machine Building", opened in the "Machine Building" pavilion at the USSR Exhibition of Economic Achievements [VDNKh]. It was organized by the USSR State Committee for Inventions and Discoveries jointly with the main state exhibition.

Microprocessing systems and highly efficient complexes, technological processes and equipment, and new progressive materials which originated from the inventions are presented at the exposition. The fact that all the products which were sent to the exhibition by the various machine building ministries and enterprises have been patented abroad and that a range of item models represent goods licensed for export testifies to the high, technical level of the inventions. More than 50 countries make use of the scientific achievements and the production know-how of the USSR. And a significant portion of the license agreements fall into the area of machine building. All this corroborates the idea that precisely here, today, the material foundation for accelerating scientific and technical progress is being laid.

All sectors of the economy need the technology which would permit repeated increases in labor productivity and significant reduction of production wastage. The products of the Belorussian Academy of Sciences Physics and Technical Institute, which is concerned with mechanization and automation of labor in machine building, possess these very characteristics.

Use of a complex for transverse-wedge milling of parts in state plants saves the economy 5 million rubles. This milling technology is virtually waste-free with the coefficient of metal utilization reaching 90 percent. The fully automated process permits a doubling or tripling of labor productivity during this operation.

Another product of the Belorussian scientists is a method for the precision stamping of gear wheels. This method, like the first invention, is licensed

for export. With this new method, labor productivity is raised by a factor of 15 to 20 and the durability of the gear wheels increases by a factor of 1.5.

The present stage of automation would not be possible without computer technology. Electronic computers and equipment are the future for all sectors of the economy.

A computer control complex for chemical-technological equipment, developed by the Scientific Research Institute for Chemical Machine Building (NIIKHIMMASH) jointly with Leningrad manufacturers, is truly a general purpose invention. It can be used in the chemical, food, coal, paper and pulp, and many other branches of industry. The new system has a developed mathematical provision that allows it to be programmed by electrical engineers who have no special training in programming.

The widespread adoption in principle of new technology which permits efficient utilization of resources is an urgent need for all sectors of the economy.

During logging operations, for example, a lot of wood capable of being valuable raw material for the most varied kinds of goods is wasted. Specialists from the Riga NPO "Silava" supplied modern technology for reworking logging waste products, providing large-scale mechanization of the entire process. That which yesterday was left in the clearings, today becomes granulated vitamin flour and technological shipping from which wood-particle board is made.

A product from the Ukrainian Scientific Research Institute for Coal Enrichment and the Scientific Research Institute of Chemical Machinery Manufacture -- a continuous vacuum suction filter -- is directed toward conserving raw materials and protecting the environment. It is intended for decantation of enriched and non-enriched coal slurry. In factories, use of the continuous suction filter, which enriches fuel coal and anthracite, cuts fuel loss waste and the output of low-grade types of fuel and increases commodity productions. The economic effect of using only one such filter is more than 72,000 rubles per year.

The creation of new progressive materials is one of the most important trends in scientific and technological progress. At the exposition are models of instruments made from synthetic semicrystalline diamonds and ceramic cutting materials, friction elements with caps of iron-based powder materials which save expensive non-ferrous metals, and non-tungsten hard alloys.

In all, more than 100 displays are presented at the exhibition, which continues until September.

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INDUSTRY PLANNING AND ECONOMICS

URALMASH PRODUCTION TARGETS, MACHINE TOOL DEVELOPMENTS

LD112154 [Editorial Report] Moscow Television Service in Russian at 1430 GMT on 11 August 1986 in the "Vremya" newscast reports that labor productivity in Uralmash is almost 8 percent up on the same period last year. Video shows plant interior, machine tools operating. The plan for equipment deliveries has consequently been overfulfilled, thanks to technical cooperation agreement with various customer sectors.

Video shows interview with man captioned as B. Ya. Orlov, chief designer of metal plate equipment. Orlov says: "Even so, the time it takes to develop new machinery can and should be reduced. This was the subject of a discussion at a party Central Committee conference in which I took part. What is it that is hindering us from developing good machinery quickly? In the first place it is the absence of a plan. Our principal customer, the Ministry of Ferrous Metallurgy, does not have plans, neither for the Thirteenth 5-Year Plan nor for the current Twelfth 5-Year Plan. And this is leading to a situation in which we are being forced to work in a way that entails planning at our own risk, as the saying goes. This often leads to wasted work; for instance, as far as metal plate equipment goes, we at present have drawings for about 100,000 metric tons of equipment on the shelf, and unusable. So what is it we want from the Ministry of Ferrous Metallurgy? That they will give us not just a simple list of jobs but rather, a document comprising and coordinating all phases in the development of a piece of machinery, from initial planning to commissioning. In our view this could be achieved through agreements between suppliers and customers for the supply of equipment being concluded at the very earliest stage of planning, and I have in mind at the stage of confirming technical specifications. If work were organized in that way, it would allow us to considerably reduce the time it takes to develop a new piece of machinery and would ensure that it is designed to the highest technical standards, which is the chief task for machine-building today."

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ROBOTICS

ACADEMICIAN FROLOV ON ROBOTICS DEVELOPMENT

LD311007 Moscow TASS in English 0953 GMT 31 Oct 86

[Text] Moscow, 31 Oct (TASS)--The Soviet Union is the first in the world practice of engineering to begin testing robots for accuracy and reliability simultaneously. This is done with the help of a test bench developed and built by the Institute for the Study of Machines under the Academy of Sciences of the USSR, Konstantin Frolov, the Institute's director and vice-president of the Soviet Academy of Sciences, told a TASS correspondent.

A new robot, Universal-5, is currently undergoing a "course of instruction" in one of the labs of the institute. As the machine covered with sensor wires is making its precise and purposeful moves, tirelessly carrying workpieces, a special computer analyzes the accuracy of each of the robot's moves and monitors the "fatigue" of its individual units and assemblies.

Such test benches are not used in labs alone. One commercial sample of the system is in operation at the Moscow-based Krasnyy Proletariy machine-tool manufacturing plant, one of the country's largest.

"The purpose of the automatic quality and reliability inspection," Frolov explained, "is to ensure superior accuracy of adjustment of the robot and of its control system at all the stages of manufacture."

Academician Konstantin Frolov said that one of the most important tasks of the country's engineering industry was not only to double the output of robots by 1990, but also to improve their quality significantly.

"This will bring us nearer to accomplishing a very important social task--reducing the share of manual labor in production by 15-20 percent by the year 1990 through a two-fold increase in the level of automation," he went on to say.

"It is quite realistic to speak about the fulfillment of that task. The first nine months of the current year have demonstrated that the campaign to re-structure and re-vitalize the engineering industry is gathering momentum--about 8,000 robots were put to work in industry over that time. Four thousand workshops and production facilities were switched to comprehensive automation and mechanization. The number of people engaged in arduous and monotonous physical work is steadily declining," the academician said.

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ROBOTICS

COMPUTER AS STEEL-MAKER

Moscow TASS in English 0700 GMT 13 Aug 86

[Text] Moscow, 13 Aug (TASS)--At the Novokramatorsk machine-building plant in the Ukraine, a computer has started to act as a steel-maker, MN INFORMATION writes. An automated control system monitoring the technological process has been put into operation.

The computer has been programmed to create any brand of steel by the method of electric slag remelting. The steel-making computer speeds up melting time, prevents errors in the technological process and, thanks to this, curtails the waste of superstrong metal.

In addition, at the metal-ladling section electronics help mould ingots very close to the form of the finished products. They will save 600 tonnes more metal every year and three shifts of steel-makers will be relieved from hard manual work.

The Novokramatorsk plant is steadily implementing the automation of labour-consuming processes--from designing to manufacturing--most for modern hydraulic presses, metal rolling mills, self-propelled excavators and other machinery.

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ROBOTICS

MACHINE TOOLS UNDER COMPUTER CONTROL

Moscow TASS in English 0607 GMT 18 Aug 86

[Text] Moscow, 18 Aug (TASS)—In conjunction with Moscow scientists Kharkov specialists have created a section of electroerosion computer controlled automatic machine tools. The system is based on an innovation developed by Soviet scientists--a method of electroerosion metal processing which helps "cut" with precision complex geometrical figures in most hard-alloyed intermediate products, MN INFORMATION writes.

At the Kharkov factory of technological fittings such machine tools process parts of high-endurance stamps in manufacturing cars, tractors, electric motors and otransformers, electronics apparatuses, etc.

At the new section the computer itself, without interference, distributes among machine tools their shift, weekly and monthly tasks. The computer also speedily corrects the amount of work to be done, taking into account the state of equipment, changes in the schedules of delivering the ready products. Refitting the machine tools for new operations takes only a few minutes.

Last year Soviet enterprises manufactured and introduced into production about 200 flexible production systems; by the end of the current five-year period (1986-1990) this amount will be tripled. It has been planned to produce every year scores of thousands of industrial robots and numerically controlled machine tools, processing centres and flexible modules.

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PROCESS CONTROLS AND AUTOMATION ELECTRONICS

REMOTE CONTROLLED BULLDOZERS, APPLICATIONS DISCUSSED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 15 July 86 p 1

[Article by V. Zhuravlev: "'Autopilot' For a Tractor"]

[Text] Voronezh--SOTSIALISTICHESKAYA INDUSTRIYA has already reported how radio-controlled bulldozers from the Chelyabinsk branch of the Scientific Research Tractor Institute (NATI) are working to eliminate the after-effects of the accident at the Chernobyl Atomic Power Station. The scientific departments for electrical technology and electric drives of the Voronezh Civil Engineering Institute (VISI) were co-designers of these machines. They were the ones who developed the tractor remote-control device.

We visited the Institute's experimental testing area where the first prototype models, fabricated by the collective of the NATI experimental plant in Pavlovskiy Posad, were being checked out.

Two, bright-orange "T-130's" were making all sorts of turns synchronously, speeding up and slowing down while simultaneously raising and lower the bulldozer blades. The cab of one of the tractors was empty, but behind the control levers of the other sat technical science candidate and senior instructor at VISI, I. Teplyakov.

"In this way," explained Yu. Avdeev, one of the design developers, "we are trying to solve, to some extent, the worker problem. For example, in construction of a land reclamation canal, bulldozers go back and forth, repeating the very same movements. But what if one could control 2 machines at one time from one tractor?"

Scientists first pondered over this problem several years ago. The concept was highly tempting: on a national scale, a great deal of manpower resources could be saved. Why, twin bulldozers could even be used for open pit coal and ore mining.

Four years of research have passed. As a result, an original system for radio remote-control of tractors has been developed. The system is supported by a range of inventor's certifications. The creative VISI collective worked in close cooperation with specialists from the Kiev Institute of Automation, the Voronezh State University, and the Siberian Institute of Road Transport in the city of Omsk.

Laboratory and field tests have shown that the choice of radio-navigation system and microprocessor was a successful one. Scientists and specialists succeeded not only in solving the problem of the "superfluous" driver, but also in radically changing the working conditions of process mechanization specialists. It turned out that the control system panel can be operated from a distance, without being in the cab, to control 2 machines at one time from a distance of 100-150 meters.

"It is very gratifying," notes M. Telyatnikov, general customer representative and leading engineer of NPO NATI, "that all of the concepts which were hypothesized in the project worked out successfully in practice. This year we want to complete testing of the equipment and, if everything continues to proceed with no deviations, as early as 1988 we will produce a prototype run of radio-controlled tractors."

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PROCESS CONTROLS AND AUTOMATION ELECTRONICS

LATHES MANUFACTURE STORAGE DISKS

Moscow TASS in English 1153 GMT 11 Aug 86

[Text] Moscow, 11 Aug (TASS)--Moscow's Krasny proletary plant has developed precision lathes making the world's smoothest surfaces with the height of microrelief of no more than 100 angstrom. Labour productivity jumps between 30 and 100 times with the use of such lathes.

They are needed to produce, above all, storage disks put out in millions. Dozens of various lathes were needed for this production under traditional technology. It was more expedient to develop special precision lathes, and they have been designed.

The Japanese Toyota firm put on show lathes of similar designation at the Metalloobrabotka-84 Exhibition in Moscow. The Japanese experts were asked to work Soviet disks, and then the results were compared. Krasny proletary's lathes eclipsed the Japanese ones in the precision of lending the form to disks: instruments did not detect any deviations in Soviet disks, while there was a slight wave on the Japanese, though within the acceptable limit. As for roughness, it could not be checked at all: the height of microrelief was below the sensitivity of instruments in both cases.

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SUPPLY, DEMAND ANALYZED FOR BETTER FMS, MACHINE TOOL EFFICIENCY

Kiev TEKHOLOGIYA I ORGANIZATSIYA PROIZVODSTVA in Russian No 3, Mar 86 pp 10-13

[Article by engineer Yu.A. Panchul: "Plans for Supplying Flexible Production Systems with Tools"]

[Text] The functioning efficiency of flexible production systems (GPS) in the metalworking industry depends to a significant extent on the level of planning of their operation. One of the basic tasks of planning is determining the demand for tools for the plan period, calculating the composition of sets of tools and establishing an order for delivering them to the machines. The solution of these problems depends on the structure of the GPS, the production program for output of parts, the technological data for machining parts, the organization of flows of parts and on the tool.

The transport-storage system of tools (TNSI) consists in a tool storehouse, adjustment and control departments, central (TsN) and interval (PN) storage and tool dispensers for machines (IM). It is possible to organize the flow of tools in the GPS in various ways (see table).

The production program of the GPS is determined by serial production and by the type of parts. The technology of machining parts is characterized by the type and quantity of tool being used for the operation and by the length of the tool's operating time.

In solving the planning problem, the most important indicators affecting GPS functioning efficiency and characterizing the flow of tools are: the utilization factor of the tool K_j , the utilization factor of the storage K_d and the coefficient of tool availability in the machine's dispenser for the next operation at the machine K_{ya} .

$$K_j = \frac{t_j}{S_j}; \quad K_d = \frac{N_d}{N_T}; \quad K_{ya} = \frac{N_{ya}}{N_{dui}}$$

where S_j is the cost of the tool; t_j is the total operating time of the tool in operation; N_T is the capacity of tool storage; N_d is the quantity of tools in it; N_{ya} is the quantity of already available tools out of the number required for the operation; N_{dui} is the necessary quantity of tools in terms of the technology.

Several methods have been developed for metering the tool flow in planning the operation of a GPS that allow optimization of tool utilization.

Ways of supplying tools to machines on a GPS

Storage	Tool Supply				
Tool warehouse	Availability of tool calculated on the whole range of parts that are machined on the GPS				
Tool adjustment & control department	24-hour supply of tools	supply of tools for subsequent 24-hour period		48-hour supply of tools	
Central storage	24-hour supply of tools	-		-	
Interval storage	-	set for one part	set for a batch of parts	set for a batch of parts	set for several batches of parts
Tool dispensers for machines	Delivery one tool at a time for the next transition	Replacement of tools calculated for operation: delivery of those lacking, dispatching of used ones while IM is overfull	Set of tools for machining a batch of parts	Delivery of set for manufacture of batch of tools	Delivery of set for one operation with next change of tools as needed
	Delivery of a set of tools for the next operation				
	Replacement of tools calculated for operation: delivery of those lacking, dispatching of used ones while IM is overfull				
	Delivery one tool at a time				
	Delivery of set for the next operation				
	Replacement of tools calculated for operation: delivery of those lacking, dispatching of used ones while IM is overfull				
	Set of tools for machining a batch of parts				
	Delivery of basic set for subsequent change of duplicate tools				
	Delivery of set for manufacture of batch of tools				
	Delivery of basic tool with subsequent change of duplicates				
	Delivery of set for one operation with next change of tools as needed				
	Delivery of a set of tools for a number of operations				
	Delivery of a set of tools for one operation				

Variant 1. The TNSI contains the TsN--a mobile conveyor with a 24-hour supply of tools (basic and stand-by) and an IM for the machines with a capacity greater than or equal to the quantity of tools needed for the operation. The production goal foresees a small range of manufactured parts. The process maintains operations with an insignificant number of long transitions. A narrow range of tools is used, with a high degree of recurrence in various operations.

In planning the operation of the GPS for a given 24-hour period, a plan-chart is set up for charging the machines with part operations. Operations are chosen not only in terms of characteristics of the parts, such as the storage supply coefficient, urgency, duration of the operation, and priority, but also in terms of the characteristics of the tool being used (their utilization factor, number of available tools out of the number needed for the operation, number of tools needed to carry out a given operation). In setting up the chosen operation, behind the machine is indicated a list of the tools that must be obtained for its fulfillment and a list of tools subject to removal from an overfull IM.

Variant 2. There is a department for the adjustment and supply of tools for the 24-hour period. Tools are put together in sets for the machining of the next batch of parts. Calculation of the set takes place in the daily planning. In the beginning of the process of analyzing technological operations and the cost of a tool, the minimal number of parts produced by one set of tools is calculated (the sub-lot). In the shift-day planning the availability of sub-lots of tools for the work place is checked. Then the procedures described in the first variant are carried out for the first part in the sub-lot, taking into consideration the number of parts in the lot. Tools of the given sub-lot going into and leaving the PN are indicated as are changes in the composition of the PN.

A model used in calculating the plan-chart allows for time to replace the tool in PN and to exchange the stand-by tools in the machine IM while machining the next parts in the sub-lot.

The necessary number of tools for a 24-hour period is calculated analogously to the first variant.

Variant 3. There is a department for the adjustment and supply of tools in the PN (truck) for the next 24 hours, a tool warehouse (TsN), IM containing tools necessary for several different operations. The production goal stipulates a large range of parts operations, and the parts manufacturing process consists of many transitions of varying duration. There is a large range of tools of varying durability with little recurrence in the operations.

First a calculation is made of the production of parts for an extended plan period (a month, ten days) with a complete supply of equipment for the sub-lots of the parts operations done with one set of tools--group tool adjustment (GIN). A determination of the minimal sub-lot is accomplished based on the average utilization factor for tools in the operation, taking into consideration the use of the basic tools of the process and their stand-bys. The sub-lot of parts operations processed by one GIN is determined at every stage of planning in calculating the machine's load.

Priority sub-lots of parts operations are chosen according to a vector evaluation of the indicators that characterize parts, tools, and work places: for machines--business, work capacity, load size, loading factor; sub-lots of parts operations--storage supply coefficient, urgency, labor input for processing, duration of all transitions in the given operation, priority, number of remaining operations according to the route; tools--the tool's average utilization factor, the utilization factor for storage, the accepted number of stand-by tools a machine has.

Optimal use of tools is achieved by choosing a set of parts such that the recurrence factor for a tool in other operations is maximal and the total number of tools does not exceed the capacity of the PN.

As a result, a work plan is composed for the GPS in terms of days of the plan period, including a plan for the tool supply of the GPS that considers the maximum tool flow to all machines and the position of the GIN and warehouse set. A list is distributed of the required tool for the plan period taking into consideration the total number of necessary tools and the maximal number of tools used simultaneously on all machines; there is also a list of the GIN set in terms of 24-hour divisions of the plan period.

In shift-day planning, the availability of prepared GINs for the given day is checked, information on the composition of the GIN is corrected in connection with the breakdown or unreadiness of the set, and the GIN on the machines is indicated. In correcting the day's goal one of the important things is the procedure for recalculating the composition of the GIN in consequence of a reduction or increase in the goal, as well as the formation of new GINs when new goals are implemented.

Then a calculation of the plan-chart is made by modelling the processes of the passage of parts along the positions of the GPS and the delivery of the GINs to the machines and their use. A count takes place here of the running time of the tool, as well as control over the demand and availability of tools.

The described methods for metering the tool flow were applied in the development of special programmed supply of a GPS planning subsystem for the production of base members and of parts like bodies of revolution. Algorithms were checked and realized on an M4030 computer, a YeS [unified system] in an OS [feedback] system; the third variant operates on an SM4 UVK [controlling computer complex] in an OS RV [traffic distributor] system.

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